MISSION SUPPORT

FISCAL YEAR 2002 ESTIMATES

BUDGET SUMMARY

OFFICE OF SPACE FLIGHT **SPACE COMMUNICATIONS SERVICES**

SUMMARY OF RESOURCES REQUIREMENTS

	FY 2000 OPLAN REVISED	FY 2001 OPLAN REVISED	FY 2002 PRES BUDGET	Page Number
	(Thousands of Dollars)			
Space Network	36,100			MS 2-4
NASA Integrated Services Network	53,600			MS 2-8
[Reimbursements [non-add]]	[43,000]			
Total	89,700			
Distribution of Program Amount by Installation				
Johnson Space Center	51,400			
Kennedy Space Center	14,000			
Marshall Space Flight Center	4,000			
Goddard Space Flight Center	17,400			
Jet Propulsion Laboratory	2,700			
Headquarters	200			
Total	89,700			

Note -- In FY 2001, funding for all these activities was requested under the Science, Aeronautics and Technology appropriation under the Space Operations program, and in FY 2002, funding for all these activities is consolidated in the Human Space Flight (HSF) appropriation account under the Space Operations program. See the crosswalk for Space Operations in the Special Issues section for comparison.

PROGRAM GOALS

The Space Communications goal is to provide high quality, reliable and cost-effective space operations services, which enable Enterprise mission execution. Reliable electronic communications are essential to the success of every NASA flight mission, from planetary spacecraft to the Space Transportation System (STS) to aeronautical flight tests.

The Space Operations Management Office (SOMO), located at the Johnson Space Center in Houston, manages the telecommunications, data processing, mission operation, and mission planning services needed to ensure the goals of NASA's exploration, science, and research and development programs are met in an integrated and cost-effective manner. In line with the National Space Policy, the SOMO is committed to seeking and encouraging commercialization of NASA operations services and to participate with NASA's strategic enterprises in collaborative interagency, international, and commercial initiatives. As NASA's agent for operational communications and associated information handling services, the SOMO seeks opportunities for using technology in pursuit of more cost-effective solutions, highly optimized designs of mission systems, and advancement of NASA's and the nation's best technological and commercial interests.

The Space Communication Services segment of NASA's Space Communications program is composed of two major elements. The Space Network element provides communications support to human space flight missions and low-Earth orbital spacecraft compatible with the Tracking and Data Relay Satellite (TDRS) system and to expendable launch vehicles and research aircraft. The NASA Integrated Services Network (NISN) program element provides telecommunications interconnectivity among NASA flight support networks, project and mission control centers, data processing centers and facilities, contractor facilities, and investigator science facilities located throughout the nation and the world.

STRATEGY FOR ACHIEVING PROGRAM GOALS

The Space Operations program provides command, tracking, and telemetry data services between the ground facilities and flight mission vehicles. This includes all the interconnecting telecommunications services to link tracking and data acquisition network facilities, mission control facilities, data capture and processing facilities, industry and university research and laboratory facilities, and the investigating scientists. The program provides scheduling, network management and engineering, pre-flight test and verification, flight system maneuver planning and analysis. The program provides integrated solutions to operational communications and information management needs common to all NASA strategic enterprises.

The Space Operations program provides the necessary research and development to adapt emerging technologies to NASA communications and operational requirements. New coding and modulation techniques, antenna and transponder development, and automation applications are explored and, based on merit, demonstrated for application to future communications needs. NASA's flight programs are supported through the evaluation and coordination of data standards and communication frequencies to be used in the future.

Many science and exploration goals are achieved through inter-agency or international cooperation. Services from NASA's Space Operations assets are provided through collaborative agreements with other U.S. Government agencies, commercial space enterprises, academia, and international cooperative programs. Consistent with the National Space Policy, NASA procures commercially available goods and services to the fullest extent feasible, NASA develops selected technologies which leverage commercial investments and enable the use of existing and emerging commercial telecommunications services to meet NASA's Space Operations needs. These are all parts of the strategic approach to providing the vital communications systems and services common to all NASA programs and to achieve compatibility with future commercial satellite systems and services.

The Consolidated Space Operations Contract (CSOC) was successfully implemented on January 1, 1999 under the direction of the Space Operations Management Office and Lockheed Martin Space Operations Company as the Prime Contractor. CSOC provides end-to-end space operations mission and data services to both NASA and non-NASA customers. CSOC is a $3.44B contract with a Basic Period of Performance from January 1999 through December 2003 and an option period though December 2008. CSOC is a Performance Based Cost Plus Award Fee (CPAF) contract. A total of nine contracts have been consolidated to date, and seven further contracts to be consolidated in FY 2001 and FY 2002. CSOC reflects a significant change in NASA philosophy as accountability and day to day direction for providing space operations services shifts from NASA to the CSOC contractor.

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BASIS OF FY 2002 FUNDING REQUIREMENT

SPACE NETWORK

	FY 2000	FY 2001	FY 2002
		(Thousands of Dollars)	
Space Network Services	4,400		
TDRS Replenishment Spacecraft	17,700		
TDRS Replenishment - Launch Services	14,000		
Total	36,100		

PROGRAM GOALS

The Space Network program goal is to provide reliable, cost-effective space-based tracking, command and data acquisition telecommunications services to the Human space Flight program, other low-Earth-orbital science missions including observatory-class flights, and selected sub-orbital flight missions. The Space Network program provides for the implementation, maintenance, and operation of the communications systems and facilities necessary to ensure and sustain the high-quality performance of NASA flight operations systems. Replenishment Tracking and Data Relay Satellites (TDRS) and the launch systems required to deploy them are also included in this program.

The Space Network participates in collaborative interagency and international programs, and independently provides communications services to other national and commercial endeavors on a reimbursable basis.

STRATEGY FOR ACHIEVING GOALS

NASA's Space Network is comprised of a constellation of geosynchronous TDRS and associated dual ground terminals located in White Sands, New Mexico. The current TDRS constellation consists of four fully operational satellites in service (TDRS-4, 5, 6 & 7), and two partially functional spacecraft (TDRS-1 & 3), and one new satellite (TDRS-H launched in June 2000), which has not yet been accepted by NASA and continued to undergo operational assessment. TDRS-1, now in its seventeenth year, is still providing service to expendable vehicle launches and other peak loads in the eastern network node.

The Goddard Space Flight Center manages the Space Network program, including the TDRS Replenishment Spacecraft program, and the modification and/or system replacement of the ground facilities and equipment as necessary to sustain network operations for current and future missions. The Replenishment Spacecraft program providing three TDRS spacecraft under a fixed-price, commercial practices contract with Boeing (formerly Hughes Space and Communications Company). The first spacecraft, TDRS-H,

was launched in June 2000. The program provides for spacecraft compatibility modifications to the New Mexico ground terminals. Lockheed Martin Corporation is the prime contractor for launch services for the TDRS Replenishment Spacecraft.

The Space Network provides communication services at data rates up to 300 megabits-per-second (MBPS) using its Ku-band single-access services, data rates of up to three MBPS using its S-band, single-access services, and a low-rate service of up to 150 kilobits-per-second (KBPS) through its multiple-access service. These services provide unparalleled, flexible high-data-rate communications capabilities for flight operations of low-Earth-orbital missions. Customer satellites are provided with command, tracking, and telemetry services via the TDRS spacecraft, which act as relays for commands from and science telemetry return to the ground terminals. The ground terminals are interconnected with flight control, data capture and processing facilities responsible for mission operations.

Communications services are provided to non-NASA customers on a reimbursable basis. A large share of the Space Network Services program that provides for the operations and maintenance of the ground terminal complex is funded with the receipts from reimbursable services.

Space Network services provides the primary communications for orbital operations of the Space Transportation System and its attached payloads. Services are also provided to automated Earth-orbital missions that have communications systems compatible with the TDRS, and can provide nearly continuous high-data-rate services. The Space Network initiated communications services for the International Space Station (ISS) beginning in FY 1999. Services will also be provided on an agreed-to basis to NASA's International partners. Agreements are in place with Japan, the European Space Agency, and Canada. Negotiations are continuing with the Russian Space Agency as a participant for potential cooperative endeavors in telecommunications.

In addition to the day-to-day operations of the Space Network satellites and ground terminals, the program provides for the replenishment of the satellite assets.

SCHEDULE AND OUTPUTS

	FY 2000		FY 2001		FY 2002
	Plan	Actual	Plan	Current	Plan
Number of hours of network service (thousands)	62,000	78,000			
Number of Space Shuttle Launches supported	6	4			

Refer to HSF 6-6 for comparison purposes to FY 2001 and FY 2002.

TDRS Replenishment Spacecraft

Pre-Environmental Review for TDRS-J Plan: February 2000 Actual: May 2000	Verification that the spacecraft is ready for system level environmental testing. Pre-environmental reviews were rephased due to a number of unit level problems on TDRS H, the uniqueness of the TDRS-H payload, and the first-time use of electronic ground test software on TDRS H.
Complete Integration and Test – TDRS-I Plan: March 2000 Revised: July 2001	Completion of spacecraft performance and environmental tests allows final assembly and re-testing to begin prior to shipment for launch.
Complete Integration and Test – TDRS-J Plan: May 2000 Revised: December 2001	Completion of spacecraft performance and environmental tests allows final assembly and re-testing to begin prior to shipment for launch.
Launch TDRS-H Plan: 3rd Qtr FY 2000 Actual: June 2000	Launch within five years of contract award will be performed, ensuring the continuity of TDRSS services to user space flight systems. Launch of TDRS-I and TDRS-J is now scheduled for 2002 and 2003.

ACCOMPLISHMENTS AND PLANS

The Space Network is required to operate 24 hours per day, 7 days per week, providing data relay services to many flight missions. In FY 2000, the missions supported included six Space Shuttle flights and their attached payloads, observatory-class spacecraft in low-Earth orbit such as Hubble Space Telescope (HST) and the Compton Gamma Ray Observatory (CGRO), as well as other compatible missions such as Ocean Topography Experiment, Extreme Ultraviolet Explorer (EUVE), Department of Defense customers, the Rossi X-ray Timing Explorer (RXTE), the Starlink research aircraft, Engineering Test Satellite (ETS-VII), Tropical Rainfall Measurement Mission(TRMM), Landsat-7 and the Long Duration Balloon program. The Space Network extended service (on a reimbursable basis) to the expendable launch vehicle community including agreements with US Air Force Titan and Lockheed Martin's commercial Atlas programs.

In FY 2000, the Space Network continued to provide services to the Space Shuttle Flights and their attached payloads as well as the construction phase of the International Space Station, LANDSAT-7, and the Earth Observing System Terra mission. Full-up support to the ISS will necessitate further increases in the level of communication services.

In FY 2000, the TDRS low power transceiver (LPT) prototype was delivered and the flight unit development was initiated. Completed LPT flight units are planned to be delivered in FY 2001.

Work began in FY 2000 on various components of the Demand Access System (DAS), including the Third Generation Beam Forming System (TGBFS). The TGBFS development activity was initiated to augment the TDRSS multiple-access (MA) capability and to permit customers to implement new operations concepts incorporating continuous return link communications. The DAS will expand existing Multiple Access (MA) return service capabilities by allowing customers to directly obtain services from the Space Network without scheduling through the Network Control Center (NCC). The TGBFS component is planned for completion in FY 2001. The DAS will be installed at White Sands, New Mexico, and is expected to be operational and available for customer use in FY 2002.

In FY 2000, the TDRS-H spacecraft was launched successfully. On-orbit checkout of the spacecraft was conducted in July-September 2000. The spacecraft is working well and meets most user service telecommunications performance requirements, except for a minor Multiple Access (MA) anomaly shortfall in performance. An investigation of the MA anomaly began in September 2000. TDRS-I and –J integration and test activities continued to progress and the TDRS-H MA anomaly is planned to be resolved in FY 2001.

BASIS OF FY 2002 FUNDING REQUIREMENT

NASA INTEGRATED SERVICES NETWORK (NISN)

	FY 2000	FY 2001	FY 2002
		(Thousands of Dollars)	
NASA Integrated Services Network.....	53,600		

PROGRAM GOALS

The NASA Integrated Services Network (NISN) goal is to provide high-quality, reliable, cost-effective telecommunications systems and services for mission control, science data handling, and program administration for NASA programs. The NISN program provides for the implementation, maintenance, and operation of the telecommunications services, control centers, switching systems, and other equipment necessary to provide an integrated approach to NASA communication requirements.

The NISN supports NASA's programs in collaborative interagency, international, and commercial enterprises. Many collaborative arrangements are performed on a reimbursable basis.

STRATEGY FOR ACHIEVING GOALS

NISN is a nationwide system of leased voice, video, and data services; leased wide-band terrestrial and satellite circuits; and control centers, switching centers, network equipment and other communications devices. International telecommunications links are also provided to NASA's Deep Space Network (DSN) sites in Australia and Spain; Spaceflight Tracking and Data Network (STDN) sites outside the Continental U.S.; and common telecommunications exchange points that provide interconnectivity to NASA international partners. Administrative, scientific, and mission control exchanges among NASA and its industrial and scientific partners are supported by NISN networks and systems. Support and participation by other U.S. agencies, universities, and research centers, and by other space-faring nations, are also facilitated, including the provision of secure circuits, systems, and facilities. Domestic Telecommunications circuits are primarily through commercial vendors; international circuits are leased under separate contractual arrangements. NISN maintains cooperative networking agreements for exchanging services with the European Space Agency (ESA), Canada, Japan, France, and Russia. The Computer Science Corporation and AlliedSignal Technical Services Corporation provide engineering and operations support for the NISN.

The NISN Project Office manages the NISN at the Marshall Space Flight Center in partnership with the Goddard Space Flight Center. NISN provides unique mission and mission support telecommunications services to all NASA Centers, supporting contractor locations, international partners, research institutes, and universities. NASA also provides telecommunications services to non-NASA customers on a reimbursable basis.

Command, telemetry, and voice systems communications are provided between spacecraft mission control facilities, tracking and data acquisition networks, launch sites, NASA data processing centers, and scientific investigators whose support is critical to mission control and command. NISN support NASA aeronautical test sites, as well as preflight verification of NASA spacecraft systems and their interconnectivity with NASA communications systems.

The NISN interconnects NASA installations and national and international aerospace contractors, laboratories, scientific investigators, educational institutions, and other Government installations in support of administrative, science data exchange, and other research and analysis activities. Specific mission support services provided by the NISN are voice and video teleconferencing, broadcast television, computer networking services, as well as data handling and transfer services including Internet connectivity.

NISN provides for the improvement, operation and maintenance of NASA network systems and facilities. Telecommunications network systems include digital voice, data and video switching equipment, audio and video conferencing and bridging systems, wide-band multiplexing equipment, and sophisticated network management, monitoring, and fault isolation systems. Equipment and facilities of NASA Select Television are also provided by the NISN.

Telecommunications services are rapidly developing and maturing. With the advancements of telecommunications technology and standards, NASA telecommunications services are now more readily available from commercial sources. NISN continually analyzes current telecommunications requirements to determine the feasibility of providing NASA telecommunications services through commercial sources. NISN also maintains a close relationship with the NASA Research and Education Network (NREN), NASA's research and development, to determine what information technologies are beneficial to support NASA's growing telecommunications needs. As technologies become standard and commercially available, NISN conducts study and cost analyses to determine the feasibility of purchasing these services for use by the NASA community.

SCHEDULE AND OUTPUTS

	FY 2000		FY 2001		FY 2002
	Plan	Actual	Plan	Current	Plan
Number of locations connected	420	347			

Refer to HSF 6-6 for comparison purposes to FY 2001 and FY 2002.

ACCOMPLISHMENTS AND PLANS

In FY 2000, NASA had major program developments in the Earth Observing System (EOS) and the International Space Station (ISS) Programs, resulting in corresponding increases in telecommunications services. For the EOS program, a 50 megabits per second (Mbps) data service was completed to support program level testing. Two 52 Mbps data services were also completed for the program, one to Norway and another to Alaska, to support the program's science data transfers.

Constrained travel budgets continue to increase the number of electronic conferences supported within NASA. Also, with the increased reliance on collaborative tools and conferencing, electronic conferences will continue to increase. As NASA enters the International Space Station (ISS) era with Principle Investigators located around the world, reliance on the networking services increases. However, increases in government-wide sponsored network services (example: very high speed Bandwidth Network Services (vBNS), Abilene, Next Generation Internet (NGI) network exchange points, Internet II), as well as industry-sponsored network services (regional Gigapops) have facilitated faster, more readily available and less expensive connectivity to many government, research, and university locations. NISN is actively involved in establishing relationships at these network connection points and in doing so will allow NISN to eliminate many dedicated services to principal researchers at locations across the US. With the establishment of a mission network based on asynchronous transfer mode (ATM) technology, many of the current dedicated point-to-point circuits will be eliminated as the network evolves to a mesh environment. This will result in decreased physical network connections, but increased virtual network connections in FY 2000-2002.

With the high level of involvement of the Russian Federation in the ISS program, NISN's telecommunications services to Russia were reevaluated and several redesigns of the services were completed to improve performance and reliability for the program. Data services were expanded to support launches at the Russian Baikonur facility, resulting in the ability to support critical communications transfers in the successful rendezvous and docking of the ISS Increment 1 crew.

In FY 2000, NISN continued to analyze commercial services for potential use in meeting NASA's expanding Mission Requirements. NASA will be adding services in support continued implementation of IFMP, CoSMO, ISS Phase II, National Oceanic and Atmospheric Administration (NOAA)-K, Earth Observation System, Advanced Composition Explorer (ACE), Advanced Earth Observing Satellite (ADEOS) and TRMM.